



Newsletter

Volume 7, Number 1
January - February 1990

At the Arboretum

One of the winter highlights at the Arboretum is our Greenhouse. Seen by many as a tropical island in a sea of winter, it gives visitors a refreshing taste of warmer, greener days.

During February and March the tropical unit is the main attraction. The Kolker Begonia Collection comprises approximately 20 varieties of begonia, all in flower at this time. Orchids are starting to bloom, followed by Hoyas in mid- to late-March. The grapefruit-sized ponderosa lemons weigh down their parent tree. Everywhere—next to the waterfall, in the cactus collection, on the side benches, hanging from the ceiling beams—there are plants with bright colors, unusual seeds and interesting textures.

The Greenhouse is open during Arboretum hours. Admission is by free visitor permit from the Gifford House. Come visit!

The IES Newsletter is published by the Institute of Ecosystem Studies at the Mary Flagler Cary Arboretum. Located in Millbrook, New York, the Institute is a division of The New York Botanical Garden. All newsletter correspondence should be addressed to the Editor.

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Dr. George Woodwell on Global Warming



Dr. George Woodwell answers students' questions at the Institute of Ecosystem Studies.

This spring, as you travel about (in an energy-efficient car), notice how much greener the trees and shrubs are 100 to 160 kilometers (60-100 miles) south of your home. If predictions about global warming come true, in another ten years that climatic zone to the south may have become yours.

Dr. George M. Woodwell, well known for his long-term studies of climatic change, recently shared his insights with scientists and students at the Institute of Ecosystem Studies. Dr. Woodwell is the founder and director of the Woods Hole Research Center (Massachusetts), an institute for global environmental research. A biologist and ecologist, he has done research on the ecological effects of ionizing radiation, on atmospheric carbon dioxide and on nutrient cycling. He is particularly interested in global warming and in the management of renewable resources. On December 15th, IES staff and members of the public filled the Plant Science Building lecture area for the concluding program in the fall IES Scientific Seminar Series, a talk by Dr. Woodwell on climatic warming. Just prior to that seminar, Dr. Woodwell met with 25 high school students who are participating in an environmental seminar program sponsored by the Gifted Resource Center of the Dutchess County BOCES (Board of Cooperative Educational Services).

Since the middle of the last century, there has been a 25% increase in the amount of carbon dioxide in the Earth's atmosphere. This increase results primarily from human activities, especially the burning of fossil fuels and the destruction of forests, that release more carbon dioxide than can be removed by plant photosynthesis or

absorbed by the oceans. The build-up of atmospheric carbon dioxide traps heat radiating from Earth, a phenomenon that has become known as the "greenhouse effect." Temperatures may increase approximately 1° C (1.8° F) each decade if carbon dioxide continues to increase at its present rate.

After a short introduction to the subject of global warming, Dr. Woodwell invited questions from the students. A sampling:

What would be the result if fossil fuel use and deforestation stopped now?

Even if we could stop the build-up of carbon dioxide now, we're committed to a 1° C increase as we experience the full effects of the heat-trapping gases already present. Immediate measures to stabilize atmospheric carbon dioxide levels will prevent an even greater increase in the carbon burden.

A major user of fossil fuels is the car. What can be done to improve the situation?

Three to five billion tons of carbon are released into the atmosphere annually by the burning of fossil fuels, and it is this quantity that we want to get rid of. We should make fossil fuels more efficient and have a large national tax on fossil fuels. Reforestation would reduce the scale of the problem as well.

What are alternate sources of energy?

Geothermal, tapping the Earth's heat, as is done in Reykjavik, Iceland; and the solar-powered electrolysis of water, splitting molecules into hydrogen and oxygen and then burning the hydrogen. Hydrogen has been used as a fuel in demonstration models of Mercedes and BMW cars.

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A Rainforest Journal, by Jill Cadwallader, IES Program Specialist in Public Information

Just across the eastern cordillera of the Andes Mountains in Ecuador is the western edge of the Amazon Basin, whose vast rainforest extends 2,600 kilometers (1,600 miles) across South America to the Atlantic Ocean. Recently, a group of scientists and naturalists went on a research expedition to Ecuador's rainforest to learn more about a remote lake in the north-eastern part of the country. I was fortunate to be part of that group.

Jan. 3rd: Our group of nine met at J.F. Kennedy International Airport for the seven-hour flight to Quito, Ecuador, the oldest capital city in South America.

Jan. 5th: The half-hour flight from Quito to the rainforest frontier town of Lago Agrio—growing rapidly as a result of Ecuador's oil industry—took us past Mount Cayambe, a volcanic peak topped by the only glacier to cross the Equator. This is the dry season, and the dusty bus ride from the Lago Agrio airport made the Río Aguarico a welcome sight. The Aguarico flows east to join the Río Napo, which in turn meets the Amazon River near Iquitos, Peru; it would be home for the next two days. Scientific gear and luggage went in one large motorized dugout canoe while we rode in a second.

Jan. 7th: After 150 km (90 mi.) of river travel we left the canoes at a military outpost and, with our guide and crew of seven, hiked to Zancudo Cocha. Zancudo Cocha (*zancudo* is Spanish for mosquito, and *cocha* is an Indian word for oxbow lake) is a small oval, tea-colored lake deep in primary forest. The trail had logs across it at regular intervals, and we learned later that these were the rollers used to move in a dugout canoe for use in our research. That canoe ferried people and possessions to our camp on the lake's western shore.

Jan. 8th: At the Equator, dawn comes just before 6 a.m. and night falls shortly after 6 p.m. We awakened at first light, not to alarm clocks but to birds, howler monkeys and the sound of breakfast being fixed in the camp kitchen. Work began right after breakfast.

The expedition leader, Dr. John Jahoda (Bridgewater College, Mass.), is doing an ongoing survey of the black caiman population in Zancudo Cocha. The black caiman, *Melanosuchus niger* (family Alligatoridae), was once abundant in Amazonia but because of its marketable hide has been hunted to the point of extinction throughout most of the Amazon Basin. Today it is listed as an endangered species. In the first research trip to Zancudo Cocha in 1986, Dr. Jahoda found evidence to suggest that the caiman

population there was a healthy one, and his goal on this trip was to collect data on population size, habitat utilization patterns and distribution.

Dr. George Milne (Pfizer Inc., Conn.), assisted by Carol and Adam Milne, collected temperature and water chemistry data and took sediment cores to learn more about the limnology and geological history of the lake.

I was in charge of plankton collection. The samples, to be sent to the Smithsonian Environmental Research Center (Md.) for study, may provide an index of the productivity of the lake.

Other work included documentation of the botany of the area by high school teacher Juan Sanchez, and a faunal study—primarily amphibians and reptiles—by our expedition medic, Jeff Corwin.

Jan. 9th: Dr. Jahoda and Melitón Rivadeniera, a crew member who proved himself to be a world-class caiman-catcher, brought in 23 animals ranging in size from 0.5 to 1.5 meters (1.5 to 5 feet). The capturing is done at night when the animals' eyes can be spotted as they reflect the men's flashlights. The animals woke us with a chorus of squeaks, grunts and splashing sounds from where they were tethered along the bank. Dr. Jahoda and his assistants measured and weighed the animals and painted bright yellow identification numbers on their heads. All were then freed at the site of capture.

Jan. 10th: I collected plankton at the first four stations and preserved the samples for later study. Sampling at the remaining eight stations was postponed until the following day, due to the unexpected arrival of 27 Indians from homes along the Río Aguarico. They were interested in meeting us, and many were hired to help carry our gear out of the jungle at the end of the stay. No complaints from us!

Jan. 11th: Dr. Jahoda took different people with him on each night's caiman



Jill Cadwallader with a Van Dorn sampler used for collecting plankton—free-floating microscopic plants and animals.

hunt. This was my turn to record data on captures and sightings. At the stern of the canoe, Antonio Llori paddled silently along the entire 8.8 km (5.5 mi.) shoreline. The night was a warm 24° C (75° F). Stars were bright, with the Southern Cross overhead. Hoatzins, primitive birds whose young have two claws at the bend of the wing, squawked and flapped noisily through the palms as we passed their loosely constructed stick nests, and an anhinga flew out over our heads and dove into the water behind the canoe. Six caiman were caught, one in a dramatic one-handed grab, and a number of previous captures were resighted before we returned to camp at 2 a.m.

Jan. 13th: An early morning bird-watching trip turned up more hoatzins, scarlet macaws, various parrots, an Amazon kingfisher, and yellow-rumped caciques circling their pouch-like nests. Some of the group went fishing and caught enough piranha for an excellent dinner. Later, Antonio led a hike along an almost invisible trail behind camp, where we sampled the refreshing liquid from pods of a Chambira palm, watched leaf-cutter ants carry leaf fragments twice their size to an underground nest, and learned how a jungle tree is transformed into a dugout canoe.

Jan. 14th: The last full day in camp. The dry season took an intermission, and it rained hard from dusk to dawn.

Jan. 15th - 20th: The trip upriver took three days, with loaded canoes moving slowly against a rain-swollen current. In Quito with time to spare, we became tourists for a day and explored Indian markets in the Andean Highlands.



L. to r.: Antonio Llori, Juan Sanchez, John Jahoda, George Milne and Melitón Rivadeniera with caiman about to be returned to site of capture.

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Cold-loving Soil Fungi

The Institute of Ecosystem Studies makes postdoctoral appointments to train outstanding young ecologists. They contribute to the Institute's program and work to establish themselves in the scientific community. Dr. Margaret M. Carreiro is one of seven postdoctoral associates currently doing research at IES.

The enrichment of soils through release of nutrients from dead organic matter is a by-product of the life processes of a host of small plants, animals and microbes that inhabit organic substrates such as soil, leaf litter and wood. One particularly important group of these decomposers is the fungi, organisms that obtain nourishment by secreting enzymes that break down organic matter so that the nutrients released may be absorbed. Decomposer fungi can be classified into two broad categories based on size: the larger mushrooms, puffballs and bracket fungi; and the smaller microfungi. It is the latter group of decomposers that are the subject of a new study at IES.

Microscopic soil fungi are not seen easily, and to be identified and studied must be isolated and grown on agar plates containing soil. Most of the research with these fungi has been done by incubating the plates at 25° C (77° F), on the assumption that few species of fungi are active in soils at lower temperatures. As a Ph.D. candidate in botany at the University of Rhode Island, Margaret Carreiro became interested in determining which soil fungi are present and active in colder soils, especially because in this part of the country the top layer of forest soils are at or below a temperature of 10° C (50° F) for five to six months each year.

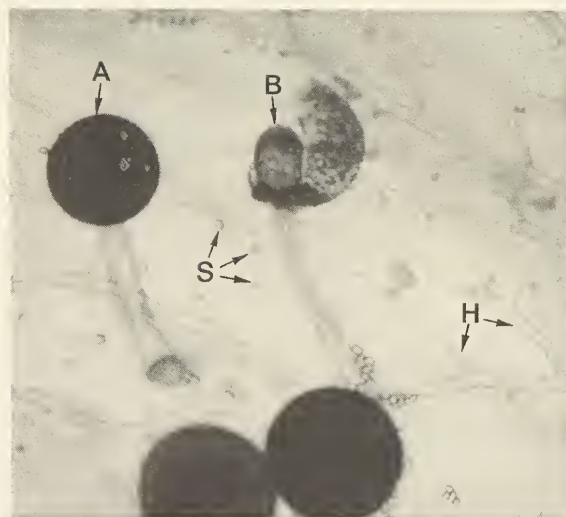
She began by collecting soil samples, plating them on agar, and incubating half

the plates at 0° C (32° F) and half at 25° C. She found totally different fungal types on the plates incubated in the cold, and almost immediately discovered two new species and rediscovered one that had not been found by scientists for 100 years. She also saw that most of the "cold-loving fungi" had different decompositional abilities than those isolated at 25° C; they belonged to fungal groups noted for breaking down chitin, the material of insect exoskeletons. This group cannot, however, break down plant cellulose, which can be decomposed by many species in the other group of fungi.

The next step in her thesis work was to use a microcosm approach to learn more about how temperature controls not only the types of fungi that can grow in forest soils and leaf litter but also the activity of these fungi. She half-filled quart mason jars with chopped deciduous leaves moistened with distilled water, and inoculated them with soil samples. She incubated the jars for two years, four at 0° C, four at 10° C and four at 20° C (68° F), the maximum temperature reached by soils 10 centimeters (4 inches) below the surface in Rhode Island. She then isolated the fungal species from each jar and measured the dry weight of the leaves to determine how much decomposition had occurred. Once again she found that the species isolated from the 0° jars differed greatly from those in the 20° jars. The fact that the weight loss at 0° was 45% of that at 20° also showed that there can be substantial activity in soils at freezing temperatures.

In November 1989, Dr. Carreiro began postdoctoral research at IES. She has isolated cold fungi from soils in this area—although no new species have been discovered here yet—and is interested in expanding her work to include how stresses caused by pollution affect the species composition and function of soil fungal communities.

Acid rain and traffic exhaust deposit chemicals and toxic metals that build up in soils. Dr. Carreiro is looking for changes in the composition and activities of soil fungi that might be signs of stress resulting from a polluted soil environment. For



Exact identification of a species of fungus often can be made only by careful observation of spores and sporangia. Shown in this photomicrograph by Dr. Carreiro are the hyphae (H) and asexual reproductive structures (sporangia) (A and B) of the microfungus *Mucor*, growing on agar. Spores (S) develop within sporangia (A) and are released when sporangia are broken (B). Spores will then germinate and grow into branched hyphae that absorb nutrients as they penetrate leaf litter and soil.

this study, she has selected sampling sites in New York City, in suburban Westchester County, N.Y., and in rural Litchfield, Conn. The sites were chosen because their plant species and soil profiles are similar, making the surrounding environment the principal variable in the experiment. Soil samples will be plated and incubated as in Dr. Carreiro's earlier research, and differences in numbers and kinds of fungal species, and/or the appearance of sterile forms, will be noted as possible indicators of stress.

Readers interested in knowing more about this subject will want to join Dr. Carreiro's June 17th Sunday Ecology Program, "Fungal Foray: There's More To the Soil Than You Think!"

Journal, from page 2

Results of the caiman study, including data from the supporting studies of biological and physical aspects of Zancudo Cocha, will be submitted for publication. In addition, we hope that knowledge of the caiman population and the natural history of the surrounding rainforest will contribute to efforts to make that area a nature preserve, safe from the development that endangers so much of the world's tropical rainforests.

This trip was organized through Nuevo Mundo Expeditions in Quito, Ecuador.



MICHAEL JOHN

Warming, from page 1

What are the big problems that research should be done on?

(The big problem is) the use of non-renewable resources by people. We are responsible for the progressive toxification of the Earth, for its poisoned forests and waters.

* * * * *

Editor's Note:

Within days of Dr. Woodwell's talk, the eastern part of the United States experienced record-breaking cold. Skeptical remarks about global warming were common.

An unusually cold period does not disprove the theory of global warming, just as the unusually hot and dry summer of 1988 did not prove that the theory was true. The theory of global warming is based on climatic conditions averaged over time—close to 130 years of data have been used in the calculations—and over space—the whole Earth. The eastern United States is just one small part of the globe and makes only a small contribution to the world's average temperature. In the same way, in any one geographic area a gradual global increase in temperature would not be expected to have a noticeable effect on that area's short-term weather patterns.

EARTH DAY April 22nd, 1990

Join us for walks and talks !

Details will be available shortly . . .

Winter Calendar

CONTINUING EDUCATION PROGRAM

A number of **winter semester classes and workshops** in landscape design and gardening begin in March and **spring semester programs** begin in April. Stop by the Gifford House or call the number below to get a copy of the Winter/Spring catalogue.

Ecological Excursions . . . Sign up by February 22nd for the March 8th trip to **The New York Flower Show**.

SUNDAY ECOLOGY PROGRAMS

Free public programs are offered on the first and third Sunday of each month, except over holiday weekends. Programs begin at 2 p.m. at the Gifford House on Route 44A. For walks, dress according to the weather, with warm, waterproof footwear. Call (914) 677-5359 to confirm the day's topic:

Mar. 4: Ecology and Earth History in Our Grandest Canyon, a slide presentation by Dr. Alan Berkowitz.

Mar. 18: The Ecology of the Sugar Maple, a walk by an IES Education Program staff member.
Apr. 1: Interpreting the History of Hudson Valley Woodlands, a walk led by Dr. Charles Canham.

Apr. 15: Easter Weekend—no program
In case of inclement weather, call (914) 677-5358 after 1 p.m. to learn the status of the program.

IES SEMINARS

The Institute's weekly program of scientific seminars features presentations by visiting scientists or Institute staff. All seminars are held in the Plant Science Building on Fridays at 3:30 p.m. Admission is free.

Mar. 2: Forest Disturbance and Organic Matter in Streams - or How the Chestnut Blight Saved Coweeta, by Dr. Jackson Webster, Virginia Polytechnic Institute and State University.

Mar. 9: Ensemble Dynamics: Local Extinction and Persistence of a Parasitoid and Its Host, by Dr. Donald R. Strong, Florida State University.

Mar. 16: Recent Ecological Society of America Initiatives in Public Affairs, by Dr. Marjorie Holland, Director, ESA Public Affairs Office.

Mar. 23: Cultural Practices and the Ecology of Maize Insects, by Dr. David Andow, Univ. of Minnesota.

Mar. 30: Topic: Lake Geochemistry, by Dr. George Kling, Marine Biological Laboratory, Woods Hole, Mass.

Apr. 6: Great Lakes Ecosystem, by Dr. Jim Kitchell, University of Wisconsin.

Apr. 20: Ecology and Evolution of Inducible Defenses, by Dr. Drew Harvell, Cornell University.

GIFT SHOP

Senior Citizens Days: On Wednesdays senior citizens receive a 10% discount on all purchases (except sale items).

Welcome-to-Spring Week, March 17-25: Daily specials.

Easter Sale, April 1-15: 10% discount on all items.

Spring perennials, including divisions from the IES Perennial Garden, available after April 15th.

ARBORETUM HOURS

(Winter Hours: October 1 - April 30; closed on public holidays)

The Arboretum is open Monday through Saturday, 9 a.m. to 4 p.m.; Sunday 1 - 4 p.m.

The Gift and Plant Shop is open Tuesday through Saturday 11 a.m. to 4 p.m. and Sunday 1 - 4 p.m. (closed weekdays from 1 - 1:30 p.m.). All visitors must get a free permit at the Gifford House for access to the Arboretum. Permits are available up to one hour before closing time.

MEMBERSHIP

Become a member of the Mary Flagler Cary Arboretum. Benefits include a special member's rate for IES courses and excursions, a 10% discount on purchases from the Gift Shop, free subscriptions to the **IES Newsletter and Garden** (the beautifully illustrated magazine for the enterprising and inquisitive gardener), and parking privileges and free admission to the Enid A. Haupt Conservatory at The New York Botanical Garden in the Bronx. Individual membership is \$30; family membership is \$40. For information on memberships, contact Janice Claiborne at (914) 677-5343.

For more information, call (914) 677-5359 weekdays from 8:30 - 4:30

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